US Fish and Wildlife Service | Determining Objectives _part 3_

[MUSIC PLAYING]

Let's go back to your endangered lizard problem. On page C-3, you had jotted down some concerns and some objectives. Now I want you to go back to that same page and think about those objectives you wrote down, and classify them. Think about which ones are fundamental objectives. Why don't you circle the fundamental objectives, but you might also note were any of those means objectives? Were any of them process objectives? Were any of them strategic objectives?

Why don't you go back? You can pause the video for a few minutes. Go back and just circle the ones you thought were fundamental, and classify the other ones, and then come back and restart the video.

OK, you're back. Hopefully, you've had a chance to look at your endangered lizard problem. It'll be different answers for each person, of course. And here's a case where you might benefit from conversation with your colleagues, and perhaps if you've got a decision analyst or consultant that you're working with that can act as a TA, you can have some good discussion around this.

But thinking about it, we were thinking about that endangered lizard at that refuge. We had objectives that had to do with the persistence of the species of the lizard. I think that would probably be a fundamental objective. I would've circled that one. That's really key to what's going on here.

I also probably would've circled something that had to do with providing bird watcher opportunities, access for bird watchers. I also probably would have had a fundamental objective that I would have circled that had to do with minimizing cost or staff time, or something like that.

There were probably some means objectives in there. If you had an objective that had something like "reduce road mortality," well, it's not that reducing road mortality is fundamental in itself. We want to reduce road mortality of that lizard because the fundamental objective is to maintain persistence of that lizard. So that's a means objective to something else, so that would have been a means objective.

Likewise, I think birder access by car or allowing vehicular access to the refuge, that might have been a means objective to achieve your bird watching goals, but there's a case where creative opportunity, creative thinking about other ways to provide that opportunity, might be valuable. So identifying that as a means objective might have been important.

So those are just some ideas from my perspective. You might have thought about it differently, but I think you probably could have identified some fundamental objectives, and perhaps a means objectives, as well, in that problem.

OK. Let's turn now to step four. Step four is about creating measurable attributes. So, here's where we're starting to get into more of the quantitative aspects of decision analysis. We've identified objectives. We've classified those objectives. We organized those objectives. We know which ones we're going to work with. We have fundamental objectives, and we now want to work with those.

Measurable attributes are how you measure the performance of those fundamental objectives. You need a way, if you're going to do your decision analysis quantitatively, to express success on scales that you can measure for each of those fundamental objectives. So, what we need is, at the lowest level of our hierarchy, we need attributes, measurable attributes, for the fundamental objectives, the ones that are at the lowest level of the hierarchy.

These attributes provide the evaluation criteria for how well your alternatives serve your objective. They're the units that you use to measure the consequences, the outcomes, of the decision alternatives. We use a lot of terms for this. We say attribute, we say performance measure, we say criterion. At any rate, these are the measurable scales on which we measure the performance of these objectives.

An attribute includes several components. An attribute includes content, that is, what it is you'll measure, but it also includes the preferred direction of the measured content. Are you increasing or decreasing it? And it also includes the aspiration. How much? Do you want to maximize? Do you want to minimize? Are you only hoping to achieve a particular threshold of satisfaction, either absolutely or relatively? So, three components-- the content, the preferred direction, and the aspiration.

Now, I'm not going to kid you. Creating measurable attributes is hard. It's often hard. We can often express our objectives, but then to talk about how we want to measure those, that can be challenging. But it's important. It's important. And what it does is really focus us and force us to think clearly about what we mean by these objectives.

Let's take an example. The example is maybe our objective is to establish a reproducing plant population. Let's say we've got a threatened species of plant-- maybe it's Mead's milkweed-- and we're

interested in establishing a reproducing plant population. That's the objective. It's got a verb, "establish." It's got an object, "reproducing plant population." What might a measurable attribute be?

Well, maybe what we'd have as a measurable attribute is the three-year mean flowering stem density. So we might be thinking about stems per meter squared-- stem density, flowering stems-- and we might be taking the mean over three years of that. So that's a measurable attribute. We can go out, and we can measure it. We can design a monitoring system for measuring stem density. We know how we're going to look at that over three years.

What's the preferred direction? Well, we want to increase this. And what's our aspiration? Well, let's say that maybe we're happy with saying that we'd just like to maximize this. We'd like this to be as big as we can possibly make it. So there's an objective of a measurable attribute that's associated with an objective.

What are some of the desired characteristics of measurable attributes? Well, we want those measurable attributes to be unambiguous. That is, we want them to have a clear relationship to the fundamental objective. This is actually kind of challenging sometimes. Sometimes we'll have a measurable attribute, but it's not really related to the fundamental objective. It's only partly related to it. I'll come back to that comment in a few minutes.

But we want it to be unambiguous. We want it to be direct. We want it to be clearly related to the consequences of interest. We would like a set of measurable attributes that's comprehensive, and we actually want each of the measurable attributes to be comprehensive in that it covers the full range of possible outcomes for that objective.

We'd like it to be operational, something we can actually use, a measurable actually we can actually use. And we want it to be understandable, readily understood, and easily communicated. These are high aspirations that we have for these measurable attributes, but that's what we're trying to shoot for.

It's useful to note that there's three kinds of attributes. At least, some folks have categorized measurable attributes in three categories-- natural attributes, constructed attributes, and proxy attributes. Let's talk about each of these in turn.

Natural attributes are measurable attributes that can be directly measured and directly reflect the objective in question, The direct measurement of the objective question.

Constructed attributes are attributes that are on some sort of relative scale, or sliding scale, or scale that you constructed. It's not a natural scale. It's not like meters, or time, or density, or population size. It's on some scale that you made up or constructed and requires interpretation on the part of the person that would be scoring it. But sometimes we're left with constructed attributes, because we don't have a measurable attribute that's on a natural scale for us.

And finally, there's proxy attributes. These are measurable attributes that are on a natural scale that's highly correlated with the objective, but is not a direct measure of it. So instead of a measurable attribute for the objective itself, we have a measurable attribute for something that's correlated with it. So I'll give you an example of those in a few minutes.

Let's look at some natural attributes. Suppose our objective was to minimize the number of employee sick days. This is an easy one. The measurable attribute might simply be the number of employee sick days.

There's something on a natural scale that we can measure. We can count out of our time and attendance logs and sum that up, and that's the number of employee sick days, and that's directly the thing that we want to minimize here. So that's a natural attribute that's directly related to the objective in question.

If we want to maximize popcorn sales, the dollars of sales of popcorn, that's a direct measure. That's a natural attribute for the thing in question.

Something a little more along the lines of the kind of problems we deal with, if we want to maintain reproductive success, maybe what we'll do is go measure the number of fledglings of birds that are coming out of this particular patch of habitat, and that number of fledgling then represents the reproductive success. That is a direct measure of reproductive success. You don't have reproductive success unless you have fledglings, so that's a direct measure. That's a natural attribute for reproductive success.

What about some constructed attributes? Well, constructed attributes, again, are things that you've constructed to represent the objective in question. Here's an example. Let's say that what we're trying to do is minimize the impact of wetland development. And so, maybe what we'll do is create five categories, and these categories go like this.

You get a score of zero if there's no loss of riparian areas and greater than 300 acres of estuary are actually restored. In that case, the wetland development impact is really quite low. In fact, there's been positive impacts. So we've that a score of zero.

Score of one if we have no loss of riparian areas, but less than 300 acres of estuary are restored. That's a score of one. Score of two, no loss of riparian areas and no loss of estuary. Score of three if you've got a loss of less than 300 acres of ripairan areas and a loss of less than 300 acres of estuary, et cetera. A score of five goes to those cases that loss of more than 300 acres of riparian areas and a loss of more than 300 acres of estuaries.

Now, you'll notice that the components of this, in this particular case, are natural scores. I mean, we can go out and measure the number riparian acres that are gained or lost. We can measure the number of estuary acres that are gained or lost. We're putting these together, then, into a constructed scale that has a score of one to five that represents our collective measure of wetland development impact. So we constructed that scale, because there is no one natural attribute that captures everything that we want.

Another example that's not in our field, but any of you with children will be familiar with, is the Apgar scores that are given to infants just moments after birth. And this is something that usually the pediatric nurse that's in the delivery room will give, and what they're doing is scoring the infant's health on five different categories-- activity and muscle tone, pulse, the grimace response, the appearance, which is skin coloration, and then respiration. And for each of these, they're given a score of zero, one, or two, where two is best. And then those scores are all added up and the score of 0 to 10 is the total Apgar score. The first test your child takes in their life, right?

And that's really a constructed scale. That score of 0 to 10 doesn't corresponded to any natural attribute in the world. There's no natural measure of health service that has a score of 0 to 10 that works like the Apgar score. But what this does is it's a constructed scale that reflects a whole bunch of things the components of which can be measured, or at least judged. And when put together on this constructed scale, you've got a measure of health at that instant of birth. So that's another example of a constructed attribute.

Finally, there's proxy attributes. And proxy attributes, as I said, are measures that are related to the objective of interest, but not necessarily directly. So, let's say your objective was to minimize student

boredom for, say, a web-delivered lecture. And maybe, what we do is we have a little spycam that captures the students as they're taking this course, and we count the number of yawns.

Well, number of yawns might be an indicator of boredom, although it might also be an indicator of how late you stayed up last night or how many other things you've got going on. It might not be directly related to your engagement in the delivery of this particular content, but it may be correlated with it. You see where I'm going with this? It's something we can measure. It's on a natural scale, but it's not necessarily directly related to the thing of interest.

We want to maintain genetic diversity? We may not be able to go out and measure genetic diversity with allele frequencies and what have you. But maybe what we'll do is we'll look at the percent of the historic and natural range that's been preserved and use that as a proxy for genetic diversity. So we might use it as a proxy attribute.

For maintain reproductive success, we gave this example of this for the natural attributes. But instead of going out and counting the number of fledglings, which would be a natural attribute for this objective, we might count the number of acres of nesting habitat and use that as a proxy. Now, there's some things that could go wrong. Just because there's nesting habitat doesn't mean fledglings are coming out of it, but we may think that there's a strong correlation, and that's a pretty good proxy.

And the reason to use proxy attributes, really, is because they might be, frankly, just easier to measure. We might have proxy attributes at our fingertips and not have corresponding natural attributes. We would prefer using natural attributes in any case, but the question about constructed attributes and proxy attributes has to do with the practicalities of what we can actually measure.

So here's a little example. This is an example of Hines Emerald Dragonfly, which is an endangered species in the Upper Midwest. And let's say we've got a little hierarchy, an objectives hierarchy. We want to ensure Hines Emerald Dragonfly persistence, and we've got three fundamental objectives--maintaining long term population persistence, maximizing the number of sites that we're able to manage, that gives us management flexibility, and maintaining the Hines Emerald Dragonfly habitat quality.

And let's suppose we developed three attributes. In the case of maintaining long term subpopulation persistence, let's say we developed a measure or prediction of the probability of harm to the

subpopulation. That's our measurable attribute. In the case of maximizing the number of sites that we're able to manage, we have an attribute that is the number of sites that we're able to manage. We count those up. And in the case of maintaining Hines Emerald Dragonfly habitat quality, let's say that we have a measure of success rate of hatching of the dragonflies, and that is high, medium, or low.

Now, what I'd like you to do is pause the video for a few seconds, and just below each of these in your notebook, I want you to write whether you think each of these measurable attributes is a natural attribute, a proxy attribute, or a constructed attribute. You can discuss that with your colleagues if you'd like, but just take a few minutes to do that, and then resume the video.

OK. How'd you do? You were asked to think about the probability of harm to a subpopulation, the number of sites that you're able to manage, and the success rate of hatching for these Hines Emerald Dragonflies of high, medium, low. Which of those are proxy, which are natural, and which are constructed attributes?

I guess I would say, to me-- the probability of harm, I guess I would say that is probably a proxy attribute. It's not a direct measure of subpopulation persistence, but what we're assuming is that if the probability of harm is low, then the probability of subpopulation persistence is high. There's other things that could be going on, so it might not be a direct measure. It might be a correlated proxy measure. But it's probably a pretty good one, or reasonable, anyway. So, I would say that one's a proxy measure.

The number of sites that we're able to manage. Well, that's a direct measure of the objective itself. That's a natural attribute.

And then, the success rate, high, medium, and low. That's a constructed attribute. What you can look for here is there's some categories, high, medium, and low. Those are not natural categories. They don't exist in nature. You would have to define what those are. You'd have to construct what those meant. And so that, I think, is a good example of a constructed attribute.

At this point, what we can do is we can turn back to the lizard management example. And so, you had developed some objectives. We had decided which one of those are fundamental. I want you to go back and take those fundamental objectives, write them down again in your notebook, and in this new table. And I want you to develop measurable attribute for three of your fundamental objectives. Develop a measurable attribute, and then I'd like you to determine the attribute type, whether it's natural, proxy,

or constructed.

And this you may want to discuss with your colleagues, and this is a good discussion point that you could have with a larger group, or if you've got a TA for the course, or something like that, to really get at this. So go ahead and pause the video at this point, and work on this exercise of developing measurable attributes, and then classifying those attributes for three of the fundamental objectives in your lizard management problem.

So, the probability of persistence of the lizard. If that was one of your fundamental objectives, then I think what you could use, probably, is if you had a PVA, if you had developed a Population Viability Analysis, and you had analyzed under a number of different scenarios what the probability of persistence was, that would be a natural attribute, a direct measure, of the objective in question. So maybe that would be your measurable attribute.

On the other hand, if you felt like you didn't have the resources to do that kind of modeling and that kind of measurement of probability of persistence, and instead you constructed some categories-- maybe high, medium, low, or maybe a score of zero to five-- that represented the degree of impact or the likelihood of persistence, and you defined each of those categories carefully, that might be a constructed attribute for the same objective.

For the objective of providing opportunity for bird watchers to use the refuge, maybe you could have a measurable attribute that was "bird watcher days." And how would you measure that? Maybe you have some surveys. Maybe periodically, you'd go out and have people with clipboards interviewing bird watchers that were on the refuge. Or maybe you have a log where people had to sign in or sign out. Or maybe when they checked in at the visitor's office, you could record something like that. Or maybe you had a camera, one of those wildlife cameras that every time a car went by with bird watchers in it, that tripped off the counter or something like that.

So a number different ways you could measure bird watcher days, and use that as a measure of the opportunity for bird watching. That's probably a natural attribute, I guess. Probably not a proxy attribute.

The cost objective, I guess, you can just dollar's spent, and that's a natural attribute. So those are just a few ideas of measurable attributes you could use for that lizard management problem. I'm sure you have other ideas, and you can discuss those perhaps with your TA.

The last step of developing objectives is this revise and repeat step. And just to reiterate again, you may have to go around this, the Proact track, before the objectives are fully understood. It may be that it's not until you've done the trade-off analysis that you realize, wait a second, there's a missing component here. There's an objective we've left out.

And I think that's OK. I think you need to recognize that often it's difficult, and there's insights that will arise later. So just give yourself permission to do that. But don't forget at each stage of subsequent analysis to be asking yourself, do I have all the objectives I need, and are they helping me distinguish among the alternatives?

So that concludes Module C. This was about objectives. We've got through the O in the Proact. From here, we go on to develop alternatives, alternative actions. And Sarah will be talking about those, and we'll proceed through the rest of the Proact sequence after that.